

## Seasonal Movement of Palaearctic Migrant Butterflies into the Indian Plains – A Substitute for or Supplement to Hibernation?

by

TORBEN B. LARSEN

Eingegangen am 9.IV.1985

### Introduction

Within the current geographical territory of India, Palaearctic butterflies are normally restricted to the Himalaya Mountain ranges, with the exception of a very few (*Pieris canidia* L., *Colias erate* ESPEY, *Argyreus hyperbius* L., *Vanessa indica* HERBST and *Kaniska canace* L.) that occur in the South Indian mountains as well. On the wetter and warmer south facing slopes of the Himalaya the first resident populations of Palaearctic butterflies normally occur at altitudes of 1500-1700 metres, but for most the lower limit is much higher, many not being found below 3000 m. The lower slopes up to 2000 m are essentially inhabited by butterflies of Oriental extraction, adapted to subtropical conditions. It is therefore of interest to note that during winter a number of Palaearctic species breed in numbers on the Indo-Gangetic alluvial plain at levels of only 300-400 metres above sea level and several hundred kilometres away from normal breeding territory. Based on my own observations during eastern 1985 an attempt is made to summarise this interesting phenomenon and to initiate a preliminary discussion on its significance.

### Observations during eastern 1985.

On 4.IV.1985 I left Delhi for a visit to Corbet National Park, situated in the Himalayan foot-hills near Ramnagar in U.P. About 70 km on the Moradabad road east of Delhi, I began to notice large numbers of white butterflies crossing the road. It was some time before I realised that they could not be *Catopsilia florel-la* F. or *Anaphaeis aurota* F., both of which were common in Delhi. They were in fact *Pieris brassicae* L. At km. 77 I stopped to take stock of the situation. Thousands of *P. brassicae* were fluttering in the ripening wheat fields, feeding on thistle and lucerne, and seeking the shade under the dense canopies of mango trees. Present were also substantial, but much more moderate numbers of *Pieris canidia* L., as well as a few specimens of *Colias fieldi* MENETRIES, several *Vanessa cardui* L., and hundreds of worn specimens of the tropical migrant *Lampides boeticus* L. During the next 110 km of driving *P. brassicae* in quantity was always in evidence. I next stopped at a large thistle patch about 20 km N of Moradabad. Here the picture was much the same as at the previous stop, though both *V. cardui* and *C. fieldi* were proportionately more common. In addition there were large

numbers of *Pontia daplidice* L. Just south of Ramnagar, immediately before the first chain of foot-hills, two additional species were met with in more moderate quantities in the form of *Colias erate* ESPEY and *Argyreus hyperbius* L. All the observations were made in agricultural land (there simply is nothing else) where known food plants for the species in question were grown as crops or occurred as weeds.

Most of these species were also observed inside the confines of Corbet National Park where they have very little if any breeding possibilities, and specimens were also seen wandering about the very dry hillsides leading up to Ranikhet where again breeding opportunities must have been almost non-existing.

Chiefly to verify these observations and study conditions at higher levels, I set off for the Mussoorie area on 12.IV.1985. I had been unable to find *P. brassicae* near Delhi and saw only a very few *P. canidia*. Just north of Meerut, as expected, large numbers of *P. brassicae*, *P. canidia* and some *C. fieldi* were seen, as well as sporadic *V. cardui*. Around Hardwar *C. fieldi* became more common and *P. daplidice* was also met with. *C. erate* and *A. hyperbius* were not observed. I did extensive driving in the mountains between 500 and 2700 m. At all levels *P. brassicae* and *P. canidia* were common, meandering over dry hillsides and through both deciduous and coniferous forests. Despite the lackadaisical flight large distances could be covered and in some valleys a flight of only two kilometres might imply a vertical displacement of 1500 m or more. At 2000 m + spring had only just started and virtually no freshly hatched butterflies of any kind were seen. Mostly hibernating species such as *Aglais caschmirensis* KOLLAR, *Vanessa indica* HERBST and *Gonepteryx rhamni* L. were seen, yet even at the highest levels many of the Pierids were worn. They have probably come up from the plains. Incidentally *G. rhamni* was seen as low as 700 m (viz my experiences in the Lebanese mountains (LARSEN, 1976)). Whenever I stopped, single specimens of *C. fieldi* and *V. cardui* could be seen flying dead straight, usually uphill, in the manner of true migrants. But there were never enough to test whether true directional movement was involved. Finally, thousands of worn *L. boeticus* could be seen everywhere.

#### Annotated list of species.

*Pieris brassicae* LINNÉ: There are sporadic records of this well known migrant from the Indian plains from many localities just south of the Himalaya, such as Lucknow, Lahore and Amritsar, as well as a few from as far south as Delhi (see WILLIAMS, 1938 for a summary). However, none of these records seem to refer to anything like the numbers observed in 1985. The main larval food plant is probably rape (*Brassica napus*) which is increasingly cultivated for oil, though long since harvested. A few larvae were found on rape growing as a weed in wheat fields. They were half grown and the plants would have been wilted long before they reached maturity. Two larvae brought to Delhi were both infested by *Apanteles*.

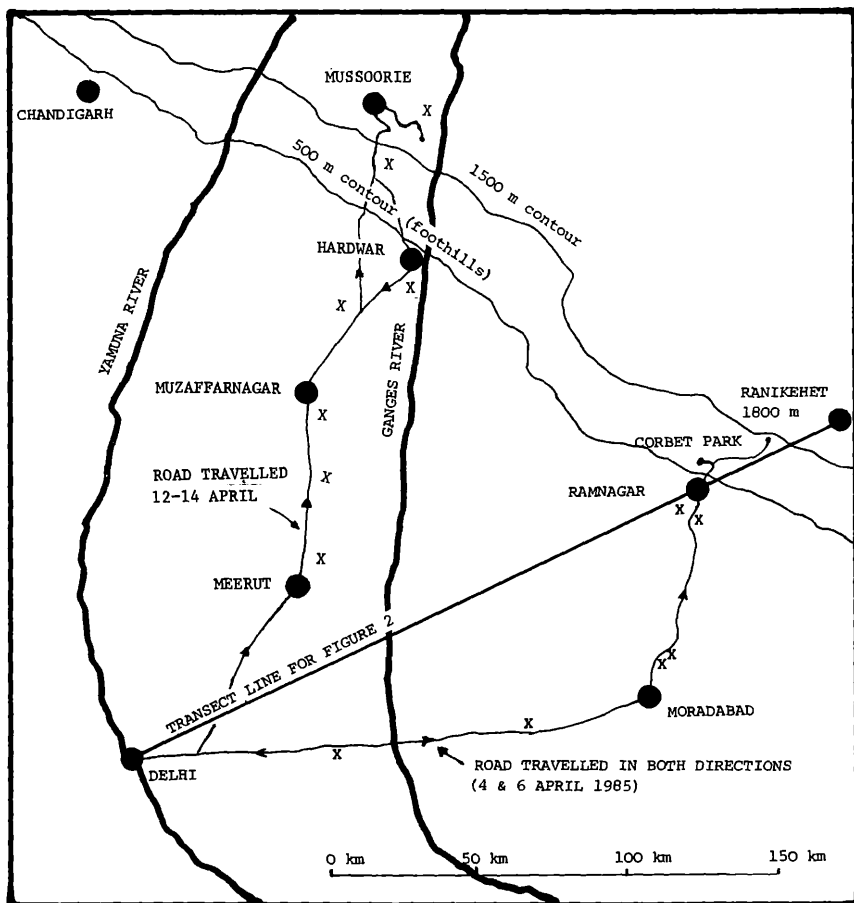


Fig. 1: Rough map of the area in which the observations were made. X denotes observation sites where I stopped, but butterflies were in evidence throughout the trip.

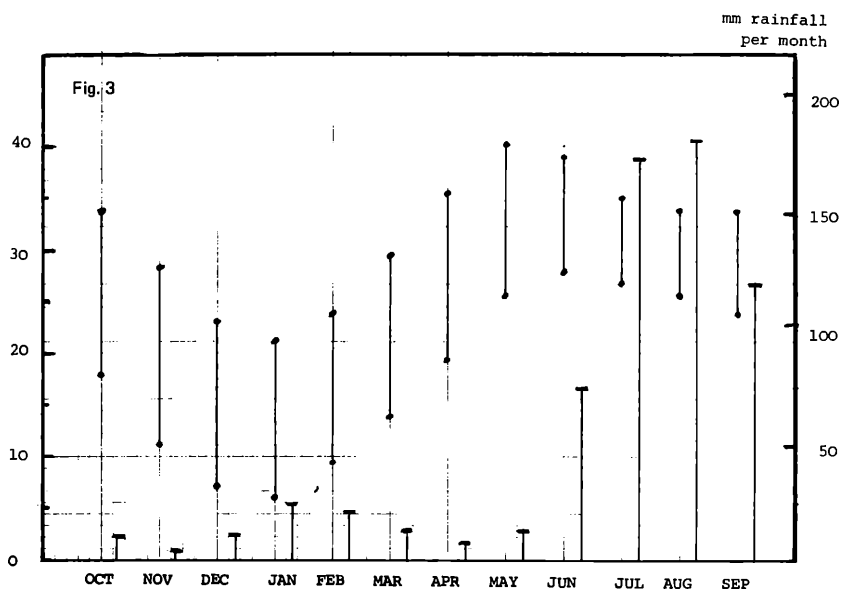
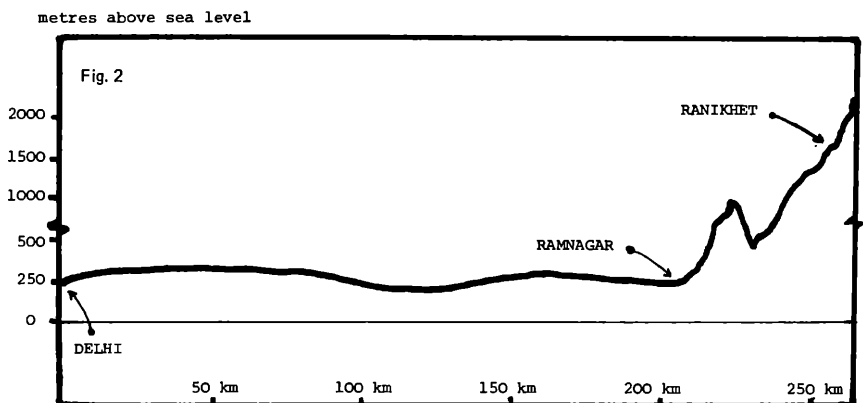


Fig. 2: Profile of the terrain between Delhi and Ranikhet (note change of scale).

Fig. 3: Left axis and the floating bars denotes average monthly mean maximum and minimum daily temperature in Delhi. The columns denote average monthly rainfall in mm per month in Delhi. It will be noted that in May the mean average daily maximum rises to 40° Celsius and that rainfall during March, April and May is negligible. Conditions between Delhi and Moradabad are basically similar (after SOHONI 1953).

*Pieris canidia* LINNÉ: This species is the Indian homologue to the European *P. rapae* LINNÉ to which it is similar in habits. It shares the Himalayan habitat with *P. brassicae*. There are again scattered records of the species from the plains in winter, and it has been found in Delhi, chiefly in April. In April 1984 it was found on several occasions in Delhi, but never in quantity. This species probably also feeds on rape, though in Delhi gardens I saw it ovipositing on cultivated *Iberis*.

*Pontia daplidice* LINNÉ: There appear to be few records of this butterfly from the plains of India, and it is not on WILLIAMS list of Indian migrants (1938). I found it common on thistles north of Moradabad, as well as in two places near Hardwar. There was also a colony at 500 m in the first range of foothills east of Mussoorie. Doubtless *Reseda* grows as a weed, though I did not see it, but the species can also feed on the same type cruciferous weeds as other Pierini.

*Colias fieldi* MENETRIES: This is the Himalayan homologue to the European *C. crocea* GEOFFR. and the African-Arabian *C. electo* L. It has been recorded sporadically from the plains, especially during February-March, and there are a few records from Delhi, where I have never seen it. DONAHUE (1967) expresses the opinion that they are non-breeding stragglers, but that is almost certainly not the case. I found the species closely linked to alfalfa (*Medicago*) and chick-pea (*Cicer*) which is widely cultivated. Though I did not see ovipositing behaviour or find larvae, the quantities involved, the concentration in fields of potential food-plants and the freshness of many specimens leaves me in no doubt that they were breeding. It may be remembered that *C. crocea* regularly breeds in the Arabian oases during winter under conditions where they could not survive summer (LARSEN, 1982, 1983).

*Colias erate* ESPER. This species seems to have been recorded only rarely from the plains [near Amritsar, Punjab (SEVASTOPULO, 1948)]. I found it in only one locality near Ramnagar in a chick-pea field where it was decidedly less common than *C. fieldi*. All specimens belong to the form with yellow dots in the forewing black band [which may be specifically distinct from *C. erate* (= *poliographus* MOTSCH)]. Otherwise like the preceding species.

*Vanessa cardui* LINNÉ: This migrant par excellence is not usually common in the lowlands of peninsular India, and records from Delhi are sporadic and mainly from the cold season. Fresh specimens were seen throughout, but usually as singles, though the species is known to occur in vast numbers on occasion.

*Argyreus hyperbius* LINNÉ: This typical fritillary has been noted from the plains as far south as Delhi during winter and spring. There are Delhi records from March and April (DONAHUE, 1967; ASHTON, 1972), but more surprisingly I collected a few fresh specimens in July 1961 as did a friend the following year (in litt.). The probable food plant is *Viola tricolor* grown in gardens and occurring also as an adventive weed. It may be that it can survive in well watered gardens in cool

years, but it is certainly not a permanent resident. I observed the species in grasslands at Ramnagar and inside the Corbet National Park. In the latter locality I spent half an hour securing specimens and trying to get a photograph on the very spot where the next day from an elephant I saw my first tiger!

## Discussion

Leaving aside the essentially nomadic *Vanessa cardui*, there is little doubt about what is happening. The species in question have their normal habitats at levels between 1500 and 4000 metres in the Palaearctic zone of the Himalaya. There are normally multiple brooded, though at their highest levels they may well be single brooded. They normally hibernate in the pupal stage, though presumably *A. hyperbius* hibernates as a young larva as seems general in the Argynnini. Part of the late (possibly only partial) broods in October/November start wandering off in search of suitable ovipositing sites which now no longer exist in their natural habitat. Lower down the mountains there are only limited breeding opportunities, but in the irrigated fields of the alluvial plain the spring crop will give ample possibilities. December and January are so cold (see fig. 3) that larval development is slow; there is occasional ground frost. By February breeding conditions in both temperature and food plant availability become ideal and this can give rise to a veritable population explosion<sup>1)</sup> in late March or early April. This is also the time the species in question most commonly are seen in Delhi, some 200 km from their natural breeding sites (see figs. 1 & 2).

April also co-incides with the onset of the breeding season in the lower part of their natural habitat as well as with the time when breeding on the plains becomes impossible. By late April all crops will have been harvested and nearly all the land will

---

1) My information is not really good enough for a quantitative estimate, but I find it helpful none-the-less to try to arrive at least at some order of magnitude indication. As may be seen from the map the observations encompass an area of about 15.000 qkm which has essentially similar ecological conditions — irrigated farmland on a flat alluvial plain. A good lucerne field (20 x 20 m) might well contain two dozen *P. brassicae*, a good patch of thistles bordering a field the same. When driving in a "good" area a specimen would be seen every ten to twenty metres, sometimes two or three at a time. In other areas there would be fewer. I would not consider it exaggerated to estimate that a least one *P. brassicae* is present for each 50 x 50 m square in the observation area on average, that is 4000 per qkm, or 60.000.000 for the whole area at a reasonably conservative estimate. Thus downward displacement has allowed the build-up of a multimillion population at a time when no breeding can take place in the natural habitat.

be parched till the onset of the monsoon. By mid-April day temperatures will begin to exceed 40°C, extended exposure to which will presumably kill both butterflies and larvae (fig. 3). It was highly noticeable that *P. brassicae* sought the dense shade of mango trees on a day when the maximum temperature was only 36°. Any butterflies staying on the plains would soon perish. Despite this I observed no major directional movement, though there appeared to be some bias towards the north, and in the mountains some uphill bias. The presence of many specimens inside very dry, open woodland without breeding opportunities also is indicative of movement. Doubtless some specimens will reach suitable breeding territory.

It is important to note that on the plains the species in question are almost wholly dependent on weeds and crops introduced by man and on irrigation. By and large it does not rain during winter (average is less than 20 mm per month and possibly decreasing due to deforestation) and March and April are among the driest months. This century has seen vast increases in the area under irrigation, first through dams and canals, later through tube wells, the foundation of India's green revolution. A population build-up of the magnitude and extent documented here would have been quite impossible a hundred years ago. There would have been only small patches of suitable breeding grounds. The present ecology is wholly artificial, and this is also reflected in the composition of the other butterflies found in the area. They are all tropical migrants and adventive species such as: *Papilio demoleus* L., *Anaphaeis aurota* F., *Catopsilia* ssp., *Eurema hecabe* L., *Junonia orithya* L., *J. almana* L., *Hypolimnas misippus* L., *Danaus chrysippus* L. and mobile crop eating skippers (*Telicota*, *Borbo* and *Pelopidas* ssp.). Only in derived desert and in the few forests or large gardens are some of the more hardy resident species seen.

There appear to be rather few precise descriptions of such large scale seasonal displacement. I suspect that some butterfly movement in the Mediterranean may have a similar background (LARSEN, 1976), but the examples appear less clear-cut. A better parallel may be that in California described by SHAPIRO (1980), who points out that many species cannot survive summer in lowland California and therefore migrate up the mountains to breed, often on alternative food plants.

Seasonal migration and hibernation/aestivation mechanisms can be seen as alternative responses to the same problem: How to ensure survival of the population in climates that do not allow permanent breeding cycles. I suspect that migration is becoming increasingly attractive as the option for the species under discussion, and it seems quite possible that the cycles of seasonal movement will gradually be refined and made more precise than they appear at the moment. Since all the species are potential (if usually minor) pests this may not be without a wider interest, and clearly the phenomenon is one with radical impact on the population dynamics of the species concerned.

Much more information on this interesting phenomenon is desirable. How regular is the migratory movement, and how much do numbers fluctuate each year?

Is the southern border dependent on density since the species obviously only reach Delhi some years? (JANDU, 1943 only saw *C. fieldi* during extensive research in 1941-42). When do the progenitors of the large March/April broods reach the plains? Have the movements and breeding increased in line with the vastly improved breeding conditions of the last hundred years? Whatever the answers it is clear that seasonal displacement is a major factor in the ecology, phenology and population dynamics of the species in question.

#### References

- ASHTON, R. (1972): Butterflies of New Delhi (Papilionoidea). — J. Bombay nat. Hist. Soc. **69**: 500-509.
- DONAHUE, J.P. (1967): Ann annotated list of the butterflies of Delhi, India. — J. Bombay nat. Hist. Soc. **63**: 235-269; **64**: 22-48.
- JANDU, A.S. (1942): Biological notes on the butterflies of Delhi. — Indian J. Ent. **4**: 201-214, and 1943, **5**: 223-241.
- LARSEN, T.B. (1976): The importance of butterfly migration to the faunas of Lebanon, Jordan and Egypt (Lep.; Rhopalocera). — Notul. entomol. **56**: 73-83.
- LARSEN, T.B. (1978): Butterfly migration in the Nilgiri Hills of South India (Lep.; Rhopalocera). — J. Bombay nat. Hist. Soc. **74**: 546-549.
- LARSEN, T.B. (1982): The importance of migration to the butterfly fauna of Arabia. — Atalanta **13**: 248-259 (basic data are updated in LARSEN, 1984, see below).
- LARSEN, T.B. (1983): Insects of Saudi Arabia; Lepidoptera, Rhopalocera (a monograph of the butterflies of the Arabian Peninsula). — Fauna of Saudi Arabia **5**: 333-478.
- LARSEN, T.B. (1984): The zoogeographical composition and distribution of the Arabian butterflies (Lepidoptera; Rhopalocera). — J. Biogeogr. **11**: 119-158.
- SEVASTOPULO, D.G. (1948): Local lists of Lepidoptera from the Punjab and UP. — J. Bombay nat. Hist. Soc. **47**: 586-593.
- SHAPIRO, A.M. (1980): Mediterranean climate and butterfly migration; on overview of the California fauna. — Atalanta **11**: 181-188.
- SOHONI, V.V. (1953): Climatological tables of observatories in India. — Government Central Press, Bombay.
- WILLIAMS, C.B. (1938): The migration of butterflies in India. — J. Bombay nat. Hist. Soc. **40**: 439-457.

Anschrift des Verfassers:

Dr. TORBEN B. LARSEN  
Personal c/o DANIDA  
7 Golf Links  
New Delhi 110003